

Originals

Astragalus (Fabaceae): Taxonomic Studies of the Plants from the Kunlun Mountains in Central Asia, 1

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This is the first treatise on *Astragalus* from the Kunlun Mountains, central Asia (between Tibetan Plateau and Takla Makan Desert). An account is given on twenty-three species found in the region. Key, description, synonymy, distribution, specimens examined, and, partly, note are given each species. Two of the twenty-three species are new to science: these are *A. nematodioides* and *A. kunlunensis*. A variety, var. *konlonicus*, is recognized in *A. densiflorus* Kar. et Kir. *Astragalus hendersonii* Baker is regarded as a variety of *A. heydei* Baker, and a new combination, *A. heydei* var. *hendersonii* is proposed.

Astragalus is the largest genus of the flowering plants consisting of 2,000 species, and also one of the most diversified genera in the mountains. Since Bunge's revisions (1868, 1869) only parts of the genus have been revised mainly on a regional basis.

This is the first treatment of the species of *Astragalus* in the Kunlun Mountains, located at the northern end of Tibetan (Qinghai-Xizang) Plateau and the south margin of Takla Makan Desert in central Asia. During the three years since 1987 large collections of plants have been made in the region by the members of expeditions organized by Chinese Academy of Sciences.

For the Kunlun representatives of *Astragalus* no comprehensive treatise has been published. The treatises on *Astragalus* in the floras of the former Soviet Union (Borissova et al. 1946) and Pakistan (Ali 1977) are most useful for circumscription of the Kunlun species. Recently a group of some Chinese taxono-

mists have started preliminary works of the Chinese species (Fu 1982a, 1982b; Y. C. Ho 1980, 1981; S. B. Ho 1983a, 1983b, Li and Ni 1979, 1985). These works are also relevant to the species occurring the mountains.

This study was principally based on the pressed specimens collected during our field researches. The first author, Ohba visited in the central and eastern part in 1988 with S. K. Wu, Y. H. Wu and Y. Fei. The third author, S. K. Wu surveyed the western part in 1987 and 1989, and the central and eastern parts in 1988 and 1989. The principal set of the specimens is kept in Kunming Institute of Botany (KUN) and the duplicate set in University of Tokyo (TI).

This paper aims to publish two new species and one variety, and also provide revised or amended descriptions of floral features for 19 species. In regard to the central Asian and Himalayan *Astragalus*, previous descriptions of flowers are mostly insufficient. In

this study flowers were dissected and observed under a binocular microscope after hydrating. Sketches were made using cameralucida.

Key to the species

- 1(a). Plant with dorabriform hair 2
- 2(a). Calyx expanding after flowering [Subgenus **Calycocystis**] 1) *A. nivalis*
- 2(b). Calyx not expanding [Subgenus **Cercidothrix**] 3
- 3(a). Acaules plants 4
- 4(a). Flowers in few flowered raceme 5
- 5(a). Leaflets 3–7, lanceolate with acute apex, 3–5 mm × 0.7–1.1 mm; flowers 6–8 mm long 2) *A. arnoldii*
- 5(b). Leaflets 1 or 3, widely obovate to obovate with obtuse apex, 16–21 mm × 9–16 mm; flowers 15–18 mm long 3) *A. monophyllus*
- 4(b). Flowers solitary at axils of radical leaves; leaflets usually 3, narrow obovate with round apex, 7–12 mm × 2.5–5 mm 4) *A. borodinii*
- 3(b). Plants with aerial stems 6
- 6(a). Peduncles 1.2–1.4 cm long; leaflets 3–5 5) *A. chomutovii*
- 6(b). Peduncles longer than 5 cm; leaflets 8–13 ... 7
- 7(a). Leaflets with obtuse apex, 6–12 mm × 2–3.5 mm; racemes compact, head-like; flowers more than 15 mm long 6) *A. petraeus*
- 7(b). Leaflets with acute apex, 6–12 mm × 1.5–1.8 mm; racemes with flowers loosely; flowers less than 12 mm long 7) *A. nematodioides*
- 1(b). Plant with simple hair only 8
- 8(a). Style or stigma hairy [Subgen. **Pogonophace**] 9
- 9(a). Upper side of apical portion of style hairy [Sect. **Trichostylus**] ... 8) *A. heydei* var. *hendersonii*
- 9(b). Stigma hairy but style glabrous 10
- 10(a). Leaflets glabrous, arranged interruptedly, 1.0–1.8 cm × 0.8–1.5 cm; fruits 4 cm long [Sect. **Chlorostachys**] 9) *A. coluteocarpus*
- 10(b). Leaflets with spreading hairs, arranged closely, 5–9 mm × 2–4.5 mm; fruits 1.0–1.3 cm long [Sect. **Pogonophace**] 10) *A. tribulifolius*
- 8(b). Style and stigma glabrous [Subgen. **Phaca**] 11
- 11(a). Stipules amplexicaule (i.e. stipules connate at stem side) [Sect. **Hypoglottis**] 12
- 12(a). Flowers 18–23 mm long; standard narrow oblanceolate 11) *A. tibetanus*
- 12(b). Flowers less than 13 mm long; standard obovate 13
- 13(a). Leaflets 8–11 pairs; flowers 11–13 mm long; calyx tube equalling to or shorter than teeth; pods c. 3 mm long stipitate 12) *A. oxyodon*
- 13(b). Leaflets (3–)5–7 pairs; flowers 7–9 mm long; calyx-tube longer than teeth; pods without stipe 13) *A. confertus*
- 11(b). Stipules free or connate at petiole side 14
- 14(a). Plants without stem, leaves all radical [Sect. **Myobroma**] 15
- 15(a). Leaflets (2–)3–5-whorled 16
- 16(a). Leaflets oblanceolate or obovate, 5–7 mm × 2–3 mm, hairs c. 0.5 mm, sparse on upper surface, dense on lower surface; stipules triangular 14) *A. alatavicus*
- 16(b). Leaflets narrow oblong or narrow oblong-ovate, 8–12 mm × 3.5–5 mm, glabrous on upper surface, hairs very dense on lower surface, soft, 1–1.7 mm long; stipules ovate 15) *A. myriophyllum*
- 15(b). Leaflets alternate or opposite 17
- 17(a). Leaflets ovate or oblong ovate, glabrous on upper surface 16) *A. andaulgensis*
- 17(b). Leaflets narrow obovate, sparsely hairy on upper surface 17) *A. talassicus*
- 14(b). Plants with aerial stem with leaves 18
- 18(a). Stipules basally connate (connate in petiole side), less than 10 mm long [Sect. **Brachycarpus**] 19

- 19(a). Uppermost leaves opposite, inflorescences terminal
 18a) *A. densiflorus* var. *konlonicus*
- 19(b). Uppermost leaves alternate, inflorescences terminal and axillary 20
- 20(a). Stems with three racemes, lowermost racemes surpassing others; bracts linear-subulate, c. 5 mm long
 18b) *A. densiflorus* var. *densiflorus*
- 20(b). Stems with one or two racemes, lower racemes surpassing upper ones 21
- 21(a). Bracts linear, 2–3 mm long
 19) *A. kunlunensis*
- 21(b). Bracts linear-subulate, 4–6 mm long 22
- 22(a). Flowers 11–13 mm long, standard narrow ovate, 13–14 mm long, calyx 8–9 mm long; leaflets 10–16 mm × 2.5–5 mm 20) *A. clarkeanus*
- 22(b). Flowers 9.5–10.5 mm long, standard oblong, 9.5–10 mm long, calyx 5–6 mm long; leaflets 18–24 mm × 7–8 mm 21) *A. fetissovii*
- 18(b). Stipules free, c. 15 mm long [Sect. **Cenanthrum**] 23
- 23(a). Leaves 8–13 cm long; leaflets widely lanceolate or narrow ovate, 2–3.2 × 0.8–1.2 cm
 22) *A. frigidus*
- 23(b). Leaves 15–18 cm long; leaflets narrow oblong-ovate or narrow oblong .. 23) *A. dictamnoides*

Systematic treatment

1. Subgenus **Calycocystis**

1) *Astragalus nivalis* Kar. et Kir. in Bull. Soc. Nat. Mosc. **15**: 341 (1842). Bunge, Astrag. **2**: 234 (1869). Baker in Hook. f., Fl. Brit. Ind. **2**: 136 (1876). Gontsch & M. Popov in Fl. URSS **12**: 824 (1946). S. B. Ho in Bull. Bot. Res. NE. Forest Inst. **3**(4): 54 (1983). C. Y. Yang in Clav. Pl. Xinjiang. **3**: 169 (1983). [Fig. 1A]

Astragalus nivalis Kar. et Kir. var. *aureocalycatus* S. B. Ho in Bull. Bot. Res. NE. Forest Inst. **3**(4): 54, t. 3 (1983).

Astragalus thomsonianus Benth. ex Baker in Hook. f., Fl. Brit. Ind. **2**: 136 (1876), pro syn.

Flowers sessile. Calyx 12–14 mm long, inflated in fruit; teeth 1.5–2.5 mm long, subulate to triangular, 1/6–1/5 of tube. Vexillum narrowly obovate, apex notched, 21–22 × 6–9 mm; Wings 20–21 mm long, lamina narrow oblong, apex notched, 8–10 mm long, shorter than claw. Keel-petals 17–19 mm long, lamina semi-orbicular, apex obtuse, shorter than claw. Ovary densely hairy. Pods semicircular, beaked, base truncate, 7–9 mm long, c. 3 mm wide, 3–4 mm deep, white hairs dense, spreading to ascending, 1–1.2 mm long, simple, straight, black hairs sparse to dense, spreading, straight, c. 0.8 mm long.

Habitat: Common on exposed sandy or stony slopes, flood river-bed and grassland, elevations between 3,000 m and 4,400 m.

Distr.: W. Himalaya, western Tibet, Kunlun, and Tien Shan, Dzhungarian Ala Tau and Tarbagatay Mts.

Specimens²⁾. XINJIANG (Sinkiang, Chinese Turkestan). Akto Xian: Qiakelake, 4,300 m. W 870636 (KUN); Aketashi, 3,200 m. W 870195 (KUN); Qiaernong, 2,980 m. WWF 4631 (KUN, TI); loc. cit., 2,800 m. WWF 5102 (KUN, TI). Hotan Xian: Kaxtax, 3,300 m. WOWF 2053 (KUN, TI); Taxkax, 3,000–3,200 m. WOWF 2575 (KUN, TI). Yutian Xian: Pulu Volcano, 4,760 m. WOWF 3700 (KUN, TI); Sukepiya, 3,000 m. W 871085 (KUN); loc. cit., 3,100 m. W 871126 (KUN). Qiemo Xian: Konqibulaker, 4,000 m. WOWF 2088 (fl. & fr.) (KUN, TI); Konqibulaker Grazing land, Lamqinam, 4,000 m. WOWF 2634 (fl. & fr.) (KUN, TI) & 3056 (fl. & fr.) (KUN). Ruoqiang Xian: Tufangzi, 4,200 m. WOWF 2771 (fr.) (KUN, TI); S slope of Qimantag Mountain, 4,400 m. WOWF 4294 (fl. & fr.) (KUN, TI); Yaziquan, 3,950 m. WOWF 3921 (fl. & fr.) (KUN, TI); Bing he, 4,200 m. WOWF 4211 (fr.) (KUN). QINGHAI (Tsinghai). Golmud Xian: 920 km in highway from Qinghai to Tibet, 4,400 m. WOWF 2823 (fr.) (KUN, TI).

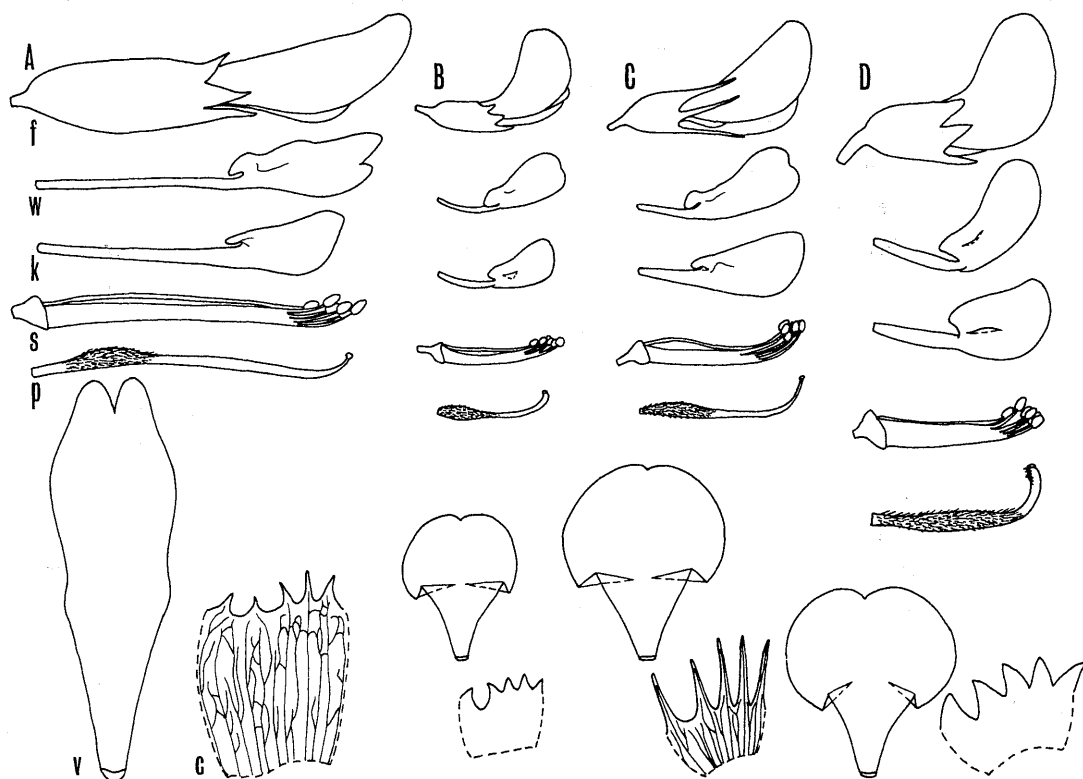


Fig. 1. A: *Astragalus nivalis* Kar. et Kir. (WOWF 5102), f: flower, w: wing, k: keel, s: stamens, p: pistil, v: standard, c: calyx. B: *A. arnoldii* Hemsl. (WOWF 4093). C: *A. nematodioides* H. Ohba et al. (WOWF 2405). D: *A. heydei* Baker var. *hendersonii* H. Ohba et al. (WOWF 2191). All $\times 2.5$.

2. Subgenus *Cercidothrix*

2) *Astragalus arnoldii* Hemsl. et H.H.W. Pearson ex Hemsl. in J. Linn. Soc. Bot. **35**: 172 (1902). S. B. Ho in Bull. Bot. Res. NE. Forest Inst. **3**(1): 61 (1983). P.C. Li et Ni in Fl. Xizan. **2**: 805, t. 259 (1985).

[Fig. 1B]

Astragalus culcitiformis P.C. Li et Ni in Acta Phytotax. Sin. **17**(2): 106 (1979).

Flowers with pedicels less than 0.5 mm long with dense blackish bifurcate hairs. Calyx 3–4 mm long, with dense white and blackish, bifurcate hairs, the teeth triangular, $1/6$ – $1/5$ of the tube. Corolla purple or purple-red, rarely white with purplish throat. Vexillum obovate, apex notched, 6 – $8 \times (3)$ – 4 – 6 mm; laminae and claws of wing and keel-petals same in length;

apex of wing slightly notched. Ovary densely hairy with 0.4 mm bifurcate, white and blackish hairs. Pods semiorbicular, c. 1 cm long, with dense appressed hairs.

Habitat: On gravelly sandy slopes in alpine desert, elevations between 4,000 m and 4,900 m.

Distr. W. Himalaya, Tibet and Kunlun.

Specimens examined. XINJIANG. Akto Xian: Aketashi, alt. 3,200 m. W870197 (KUN). Yutian Xian: Pulu Volcano, Luker Lake, 4,700 m. WOWF 3704 (KUN, TI); Ulugkula Lake, 4,900 m. WOWF 3730 (KUN, TI). Qiemo Xian: Kongqibulaker, 4,000 m. WOWF 2597 (fl. & fr.) (KUN, TI); loc. cit. 4,050 m. WOWF 2072 (KUN, TI) & 2071 (KUN). Pishan Xian: Shanxuanwan, Hangyangtang, 4,900 m.

WWF4747 (KUN, TI). TIBET. Baingoin Xian: Whale Lake, 4,880 m. WOWF 4093 (fl. & fr.) (KUN, TI).

3) *Astragalus monophyllus* Bunge ex Maxim. in Bull. Acad. Sci. St.-Petersb. **26**: 473 (1880). Grubov in Key Vas. Pl. Mongol: 160, t. 84, 386 (1982). H. C. Fu in Y. C. Ma, Fl. Intra Mongol., ed. 2, **3**: 271, t. 105, 11–16 (1989). [Fig. 3 (below)]

Astragalus macrotrichus Pet.-Stib. in Acta Hort. Gotob. **12**: 67 (1938). H. C. Fu in Y. C. Ma, Fl. Intramongol. **3**: 205, t. 105, 1–9 (1977). S. B. Ho in Bull. Bot. Res. NE. Forest Inst. **3**(1): 54 (1983).

Flowers with c. 2 mm long pedicel. Calyx 13–14 mm long, cylindrical, densely hairy; tube 8–9 mm long; teeth 4–5 mm long, linear-subulate. Corolla cream yellow. Pods ellipsoid, 2.4–2.8 cm long, 0.8–1.0 cm deep, apex beaked, base cuneate, hairs dense, bifurcate, spreading, white, slightly curled, 1–2 mm long.

Habitat: On sandy banks or gravels in desert, elevation between 3,650 m and 4,730 m.

Distr.: Kunlun and Mongolia (Altai and Alashan).

Specimens. XINJIANG. Ruqiang Xian: Yaziquan, 3,650 m. WOWF 2640 (fr.) (KUN); loc. cit., 4,730 m. WOWF 4240 (fr.) (KUN, TI).

The vegetative and fruit characters of the Kunlun plants well agree with those of the type collected in Inner Mongolia (E. MONGOLIA. Ad tractum mervatorium, prope Zaghan-tururik. Kirilow 642 in 1842, LE). This species represents an extraordinary pattern of geographic distribution of the Kunlun plants.

4) *Astragalus borodinii* Krassn. in Script. Hort. Univ. Petrop. **2**: 15 (1887 or 88). Boriss. in Fl. URSS **12**: 581, t. 35, 1 (1946). S. B. Ho in Bull. Bot. Res. NE. Forest Inst. **3**(1): 54 (1983). C. Y. Yang in Clav. Pl. Xinjiang. **3**: 159 (1983). [Fig. 2A]

Flowers solitary at axils of radical leaves, sessile, c. 26 mm long; bracts triangular ovate, densely hairy, 3–8 mm × 2 mm; bracteoles 1, linear, c. 5 mm × 0.5 mm. Calyx c. 11 mm long, with dense white bifurcate hairs up to 2 mm long; tube c. 7 mm long; teeth linear

to subulate, c. 3 mm long. Corolla powder red? Vexillum c. 25 mm × c. 6 mm, narrow obovate, apex truncate to slightly retuse, base auriculate. Wings 20–21 mm long; lamina narrowly oblong-obovate, 11–12 mm long. Keel-petals 16–17 mm long, lamina semiorbicular, c. 7 mm long, shorter than claw c. 10 mm long. Pistils c. 1.7 cm long; ovaries 4–5 mm long, sessile, densely pubescent, hairs appressed, 1–1.5 mm long.

Habitat: On stone slopes, elevation between 2,200 m and 3,400 m.

Distr.: Pamir, Kunlun, Tien Shan, Dzhungarian Ala Tau, and Borborogussun Range.

Specimens. XINJIANG. Akto Xian: Qiakelake to Muji, 3,400 m. W870584 (KUN). Wuqia Xian: Konyusu, 2,200 m. W870002 (KUN); Jigan, 2,800 m. W870056 (KUN).

5) *Astragalus chomutovii* B. Fedtsch. in Bull. Herb. Boiss. **7**: 826 (1899). Gontsch. in Fl. URSS **12**: 593, t. 35, 2 (1946). S. B. Ho in Bull. Bot. Res. NE. Forest Inst. **3**(1): 60 (1983). C. Y. Yang in Clav. Pl. Xinjiang. **3**: 160 (1983).

Habitat: On stony slope, elevation around 3,700 m.

Distr.: Pamir (Alai Valley), western Kunlun and Tien shan.

Specimen. XINJIANG. Taxkorgan Xian: Maza, 3,700–3,800 m. W 870389 (KUN).

Astragalus wensuensis S. B. Ho is probably falls in the variation range of this species.

6) *Astragalus petraeus* Kar. et Kir. in Bull. Soc. Nat. Mosc. **15**: 333 (1842). Bunge, Astrag. **2**: 221 (1869); Astrag. Turk.: 286 (1880). Boriss. et al. in Fl. URSS **12**: 532 (1946). S. B. Ho in Bull. Bot. Res. NE. Forest Inst. **3**(1): 46 (1983). C. Y. Yang in Clav. Pl. Xinjiang. **3**: 161 (1983). [Fig. 2B]

Flowers c. 1.6 cm long, pale yellow, sessile. Calyx c. 9 mm long, appressed- to ascending-hairy with brown straight hairs 0.6–0.8 mm long and white curved hairs 0.6–1 mm long; tube 6–7 mm long; lobes c. 2 mm long, subulate. Vexillum obovate, c. 16

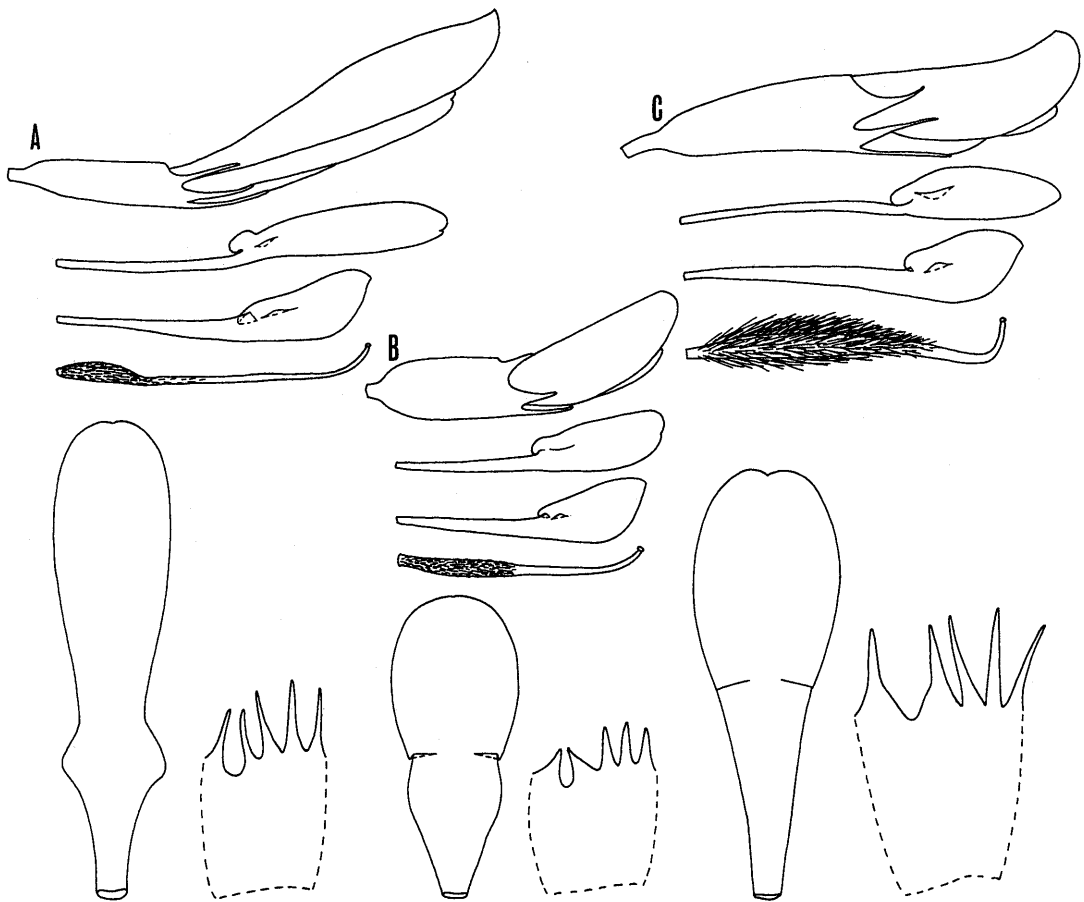


Fig. 2. A: *Astragalus borodinii* Krassn. (W 870584). B: *A. petraeus* Kar. et Kir. (W 870057). C: *A. andaulgensis* B. Fedtsch. (W 870504). All $\times 2.5$.

mm \times c. 7 mm, apex truncate, base slightly auriculate. Wings c. 14 mm long, lamina narrow obovate, c. 7 mm long, apex slightly retuse. Keel-petals slightly shorter than wings; lamina semi-orbicular, c. 6 mm long, shorter than claw c. 8 mm long. Pistils c. 13 mm long; ovaries c. 2.5 mm long, hairy, stipe c. 0.5 mm long.

Habitat: On stony mountain slope, elevation 2,800–3,200 m.

Distr.: Pamir (eastern Alai Valley), western Kunlun, Tien Shan, and Dzungarian Ala Tau.

Specimen. XINJIANG. Wuqia Xian: Jigen, 2,800–3,200 m. W 870057 (KUN).

7) ***Astragalus nematodioides*** H. Ohba, S. Akiyama et S. K. Wu, sp. nov.

[Figs. 1C; 4 (above)]

Astragali nematodis Bunge ex Boiss. primo adpectu maxime similis, sed foliis brevioribus quam 4 cm longis et foliolis anguste oblanceolatis 6–12 mm longis 1.5–1.8 mm latis differt.

Perennial herb with a buried caudex with many short divisions. Stems 0.5–2 cm long, densely hairy, usually 3–5 nodes. Leaves 2–4 cm long, ascending, hairs white, bifurcate, c. 1 mm long; petioles 1.5–2 cm long, densely hairy; leaflets 4–6 pairs, greyish green, narrow oblanceolate, apex acute, base attenuate, ses-

sile, 6–12 mm \times 1.5–1.8 mm, densely hairy on both surfaces. Stipules connate throughout to lower two third, amplexicaule, triangular-ovate to triangular, hairy, brownish, 2–4 mm long.

Inflorescences axillary, raceme with 6–13 flowers, 2–6 cm long; peduncles erect, up to 13 cm long, conspicuously longer than stems (protruding?), hairy; bracts lanceolate, 1.5–2 mm long, hairy.

Flowers with c. 1 mm long, hairy pedicels. Calyx 3–6 mm long, hairy; teeth 2–4 mm long, subulate, longer than tube. Vexillum widely obovate, apex emarginate, 7–10 \times 5–9 mm. Wings 7–9 mm long, lamina narrow oblong, apex emarginate, 2 times longer than claw. Keel-petals 7–9 mm long; lamina semi-orbicular, apex obtuse, longer than claw. Ovary densely hairy. Pods flat, linear, arched, apex with beaked like persistent style, base tapering, 10–15 mm long, hairs dense white, appressed to spreading, up to 1 mm long, bifurcate and often simple.

Type: China. Xinjiang: Qira Xian, Yamei, alt. 3,000 m. Wu, Ohba, Wu & Fei 2522 (KUN-Holo; TI-Iso).

Habitat: In various exposed grounds such as desert, riverbeds, grazings, hill side slopes, and rarely in the sparse forest floors, elevations between 2,420 m and 3,700 m.

Distr.: Endemic to the Kunlung Mts.

Specimens. XINJIANG. Akto Xian: Aketashi, 2,420 m. W 870260 (KUN). Pishan Xian: Buqun, 2,750 m. WOWF 1831 (KUN, TI); Kaxtax, 2,800 m. WOWF 3611 (KUN, TI); Naoarbati, 3,000 m. WOWF 2405 (KUN, TI); Naoarbatibuqiong, 2,600 m. WOWF 2443 (KUN, TI); Habake Daban, 3,700 m. WWF 4771 (KUN). Yutian Xian: Kekeya to Momoke, 2,700 m. W 870970 (KUN); Pulu to Pulu Volcano, 3,100–3,500 m. WOWF 3671 (KUN, TI). Qira Xian: Nuer, 3,200 m. WOWF 1993 (KUN, TI); Yamei, 3,000 m. WOWF 2522 (KUN, TI). Qiemo Xian: Kongqibulaker, 3,000 m. WOWF 2584 & 2585 (fl. & fr.) (KUN, TI); loc. cit., 3,150 m. WOWF 2063 (fl. & fr.) (KUN, TI);

Aqiaagxiang, Kongqibulaker Grazing land, 3,250 m. WOWF 3843 (fr.) (KUN, TI).

This species is somewhat similar to *Astragalus nematodes* Bunge ex Boiss. distributed in Kazakhstan, but differs in having shorter leaves less than 4 cm long, shorter narrow oblanceolate (6–12 mm long) leaflets and flowers less than 1 cm long.

3. Subgenus **Pogonophace**

Sect. **Trichostylus**

8) *Astragalus heydei* Baker in Hook. f., Fl. Brit. Ind. **2**: 118 (1876). Hemsley in J. Linn. Soc. Bot. **35**: 172 (1902).

Var. *hendersonii* (Baker) H. Ohba, S. Akiyama et S. K. Wu, stat. nov. [Fig. 1D]

Astragalus hendersonii Baker in Hook. f., Fl. Brit. Ind. **2**: 120 (1876). Type: Upper Karakash Valley. Henderson in 1870 (K). Ali in Sind Univ. Sci. Res. J. **2**(2): 1 (1967); in Fl. West Pakist. **100**: 126 (1977). K. T. Fu in Bull. Bot. Res. NE. Forest Inst. **2**(1): 119 (1982), ut '*hendersonii*'. P.C. Li et Ni in Fl. Xizan. **2**: 809 (1985).

Calyx 5–6 mm long, densely hairy with less than 0.6 mm long, white and brownish hairs; teeth 1.5–2.5 mm long, triangular. Vexillum very widely obovate, apex retuse, 9–12 \times 9–12 mm. Wings 8–11 mm long, lamina oblique, narrow oblong, apex round, longer than claw. Keel-petals 7–10 mm long, lamina semi-orbicular, apex around, claw as long as lamina. Style in apical portion (at least the upper side) and stigma hairy. Ovary densely hairy.

Habitat: On sandy or gravelly slopes or desert, elevations between 3,200 m and 5,300 m.

Distr.: W. Himalaya (Kashmir), Tibet, Kunlun, and S. Qinghai.

Specimens. XINJIANG. Yutian Xian: Tianwenggan, 5,100 m. W 871246 (fr.) (KUN). Ruoqiang Xian: Piaqiriketagar, 3,900 m. WOWF 2155 (fl. & fr.) (KUN, TI); Aqqikkol, 3,250 m. WOWF 2191 (fl. & fr.) (KUN, TI); loc. cit., 4,280 m. WOWF 4035 (fl. & fr.) (KUN, TI); Yaziquan to Aqqikkol, 4,000 m.

WOWF 2651 (fl. & fr.) (KUN, TI); Mingyalakdong, 4,100 m. WOWF 4191 (fr.) (KUN, TI). TIBET. Ritu Xian: Madau, 4,500 m. W 871334 (fr.) (KUN); Nongmucuo, 5,300 m. W 871311 (fr.) (KUN). Baingoin Xian: Whale Lake, 4,800–4,900 m. WOWF 4108 (fl. & fr.) (KUN, TI); NW of Whale Lake, 5,100 m. WOWF 2709 (KUN, TI); NEN of Whale Lake, 5,000 m. WOWF 2229 (KUN, TI). QINGHAI. Golmud Xian: 920 km in highway from Qinghai to Tibet, 4,400 m. WOWF 2807 (fl. & fr.) (KUN, TI).

Variety *hendersonii* differs from var. *heydei* by the leaflets with dense hairs on both sides and the long claws. In this species the hairiness on the upper surface of leaves are constant within populations. Var. *heydei* has been not found in the Kunlun Mts.

Sect. *Chlorostachys*

9) *Astragalus coluteocarpus* Boiss., Diagn. Pl. Orient.: 65 (1849); Fl. Orient. 2: 271 (1872 or 73). Baker in Hook. f., Fl. Brit. Ind. 2: 130 (1876). Gontsch. in Fl. URSS 12: 23 (1946). [Figs. 3 (above); 5A]

Astragalus dshimensis Gontsch. in Not. Syst. Inst. Bot. Acad. Sci. URSS 10: 30 (1946); in Fl. URSS 12: 23 (1946). Type: TIEN SHAN. Iter Turkestanicum: Montis Irenchabirga, 5–8,000 ft. Regel 15 Mai 1879 (LE-holo); loc. cit., Bainamunbes, Dschin, 5–6,000 ft. Regel in 1879 (LE-para). K. T. Fu in Bull. Bot. Res. NE. Forest Inst. 2(1): 132 (1982). C. Y. Yang in Clav. Pl. Xinjiang. 3: 122, t. 7, 2 (1983), syn. nov.

Calyx remaining in fruit with simple hairs c. 13 mm long; teeth c. 4 mm long, subulate. Vexillum 20–21 × 10–12 mm, narrow obovate, apex retuse. Wings c. 20 mm long, lamina linear-lanceolate, apex round, claw shorter than lamina. Keel-petals 18–20 mm long, lamina semi-orbicular, apex round, claw shorter than lamina. Ovary long stipitate, style hairy at apical portion. Pods linear, 4 cm × 0.5 cm, glabrous.

Habitat: On gravel banks, elevation 2,800 m.

Distr.: Afghanistan, W. Himalaya (Hindkush eastward to Kunawar), Pamir, Kunlun, Tien Shan, and Dzungarian Ala Tau.

Specimen. XINJIANG. Yarkand: Henderson 23 June 1870 (K). Ruoqiang Xian: Hongliugou to Mangnai, 2,800 m. WOWF 2132 (fl. & fr.) (KUN, TI).

Astragalus dshimensis falls in the variation range of *A. coluteocarpus* Boiss. in the vegetative and floral (including) features. The Himalayan representatives are smaller than those of Kunlun and Tien Shan. The epithet *dshimensis* might be a printing error, *dshihensis*, which is derived from *Dshihe* River now known as *Jinghe*.

Sect. *Pogonophace*

10) *Astragalus tribulifolius* Benth. ex Bunge, Astrag. 1: 4 (1868); 2: 2 (1869). Baker in Hook. f., Fl. Brit. Ind. 2: 120 (1876). Ali in Fl. West Pakist. 100: 125 (1977). K. T. Fu in Bull. Bot. Res. NE. Forest Inst. 2(1): 120 (1982), cum var. *pauciflorus* Marquand et Shaw. P. C. Li et Ni in Fl. Xizan. 2: 813, t. 263, 1–9 (1985). P. Q. Li in Vasc. Pl. Hengduan Mts. 1: 953 (1993).

Astragalus tribulifolius Bunge var. *pauciflorus* Marquand et Shaw in J. Linn. Soc. Bot. 48: 171 (1929).

Flowers with c. 1 mm long pedicels. Calyx 4–4.5 mm long, densely spreading-hairy with blackish, c. 0.2 mm long and white c. 0.5 mm long hairs; tube 2.0–2.5 mm long; teeth 2.0–2.3 mm long, triangular. Corolla red purple. Pods ellipsoid, apex acute, base widely cuneate, 10–13 mm long, 4–5 mm deep, hairs sparse, blackish, spreading, c. 0.3 mm long; unilocular, many seeded.

Distr.: Himalaya (Kashmir and ? Sikkim), Kunlun, Tibet, and N. and SW. China (Gansu & Sichuan).

Specimen. TIBET. Ritu Xian: Madau, 4,500 m. W 871336 (fr.) (KUN).

4. Subgenus *Phaca*

Sect. *Hypoglottis*

11) *Astragalus tibetanus* Benth. ex Bunge, Astrag. 1: 52 (1868); 2: 85 (1869). Boiss., Fl. Orient. 2: 250 (1872 or 73). Baker in Hook. f., Fl. Brit. Ind. 2: 124

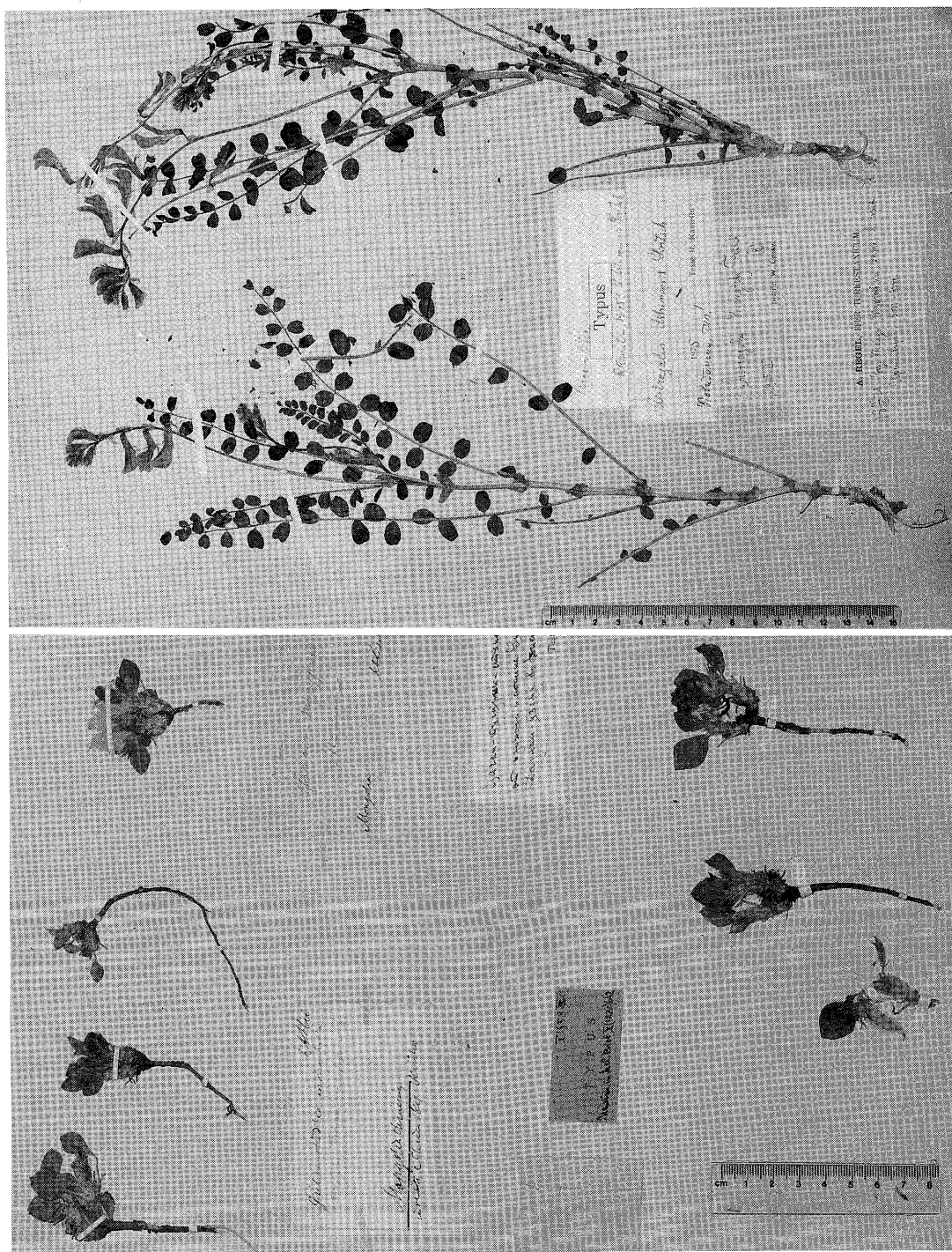


Fig. 3. *Astragalus coluteocarpus* Boiss. (above). Holotype of *A. dshimensis* Gontsch. (Regel 15 Mai 1879, LE). *A. monophyllus* Maxim. (below). Holotype (Kirilow 642 in 1842, LE).

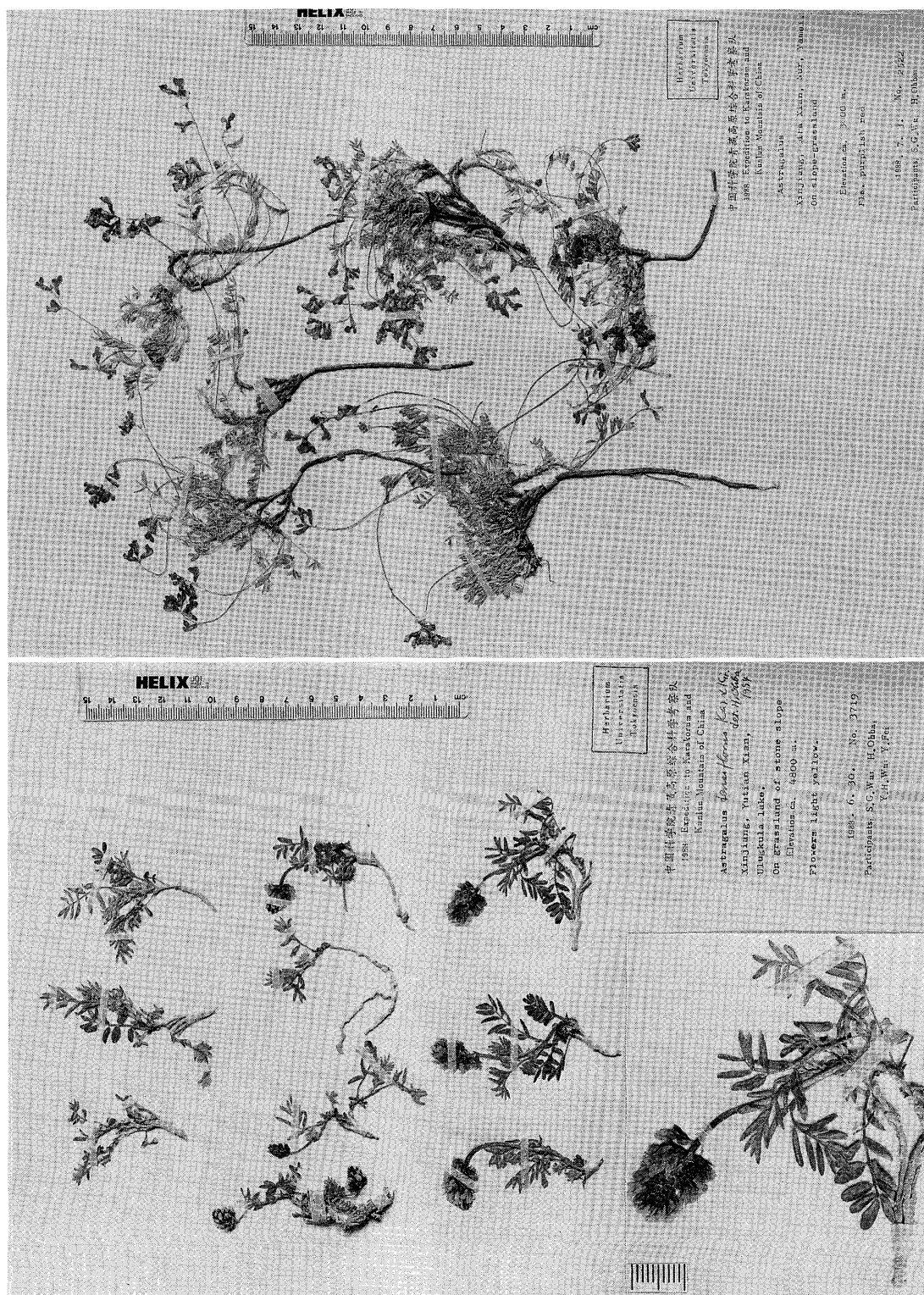


Fig. 4. Types of *Astragalus nematoidoides* H. Ohba et al. (WOWF 2522, TI) (above) and *A. densiflorus* var. *konlonicus* H. Ohba et al. (WOWF 3719, TI) (below).

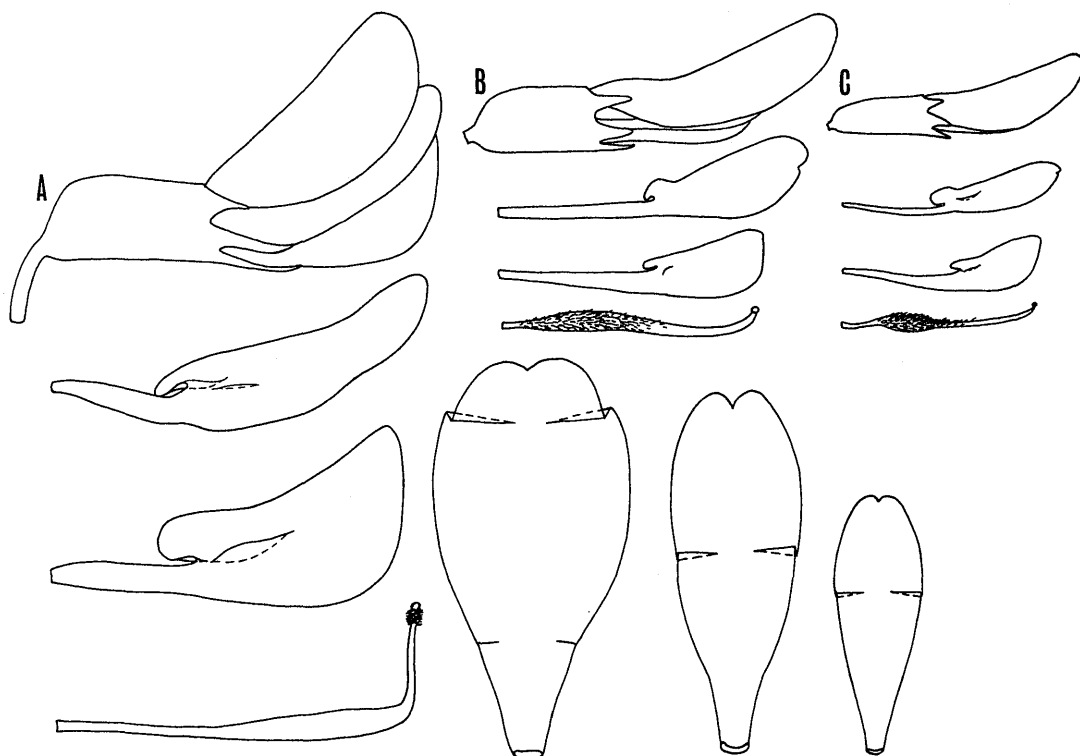


Fig. 5. A: *Astragalus coluteocarpus* Boiss. (WOWF 2132). B & C: *A. tibetanus* Benth. ex Bunge, B: Xinjiang (WOWF 3858), C: Pakistan (Ohba et al. 77, TI). All $\times 2.5$.

(1876). Gontsch. et Boriss. in *Fl. URSS* **12**: 258 (1946). Reching. f., *Symb. Afghan.* **3**: 39 (1957). Kitam., *Fl. Afghan.*: 193 (1960). Ali in *Fl. West. Pakist.* **100**: 180 (1977). K. T. Fu in *Bull. Bot. Res. NE. Forest Inst.* **2**(1): 73 (1982). C. Y. Yang in *Clav. Pl. Xinjiang.* **3**: 138 (1983). P. C. Li et Ni in *Fl. Xizang.* **2**: 843 (1985). [Figs. 5B & C]

Astragalus chadjanensis Franch. in *Bull. Mus. Hist. Nat. Paris* **2**: 344 (1869).

Astragalus tibetanus Benth. var. *patentipilus* K. T. Fu in *Bull. Bot. Res. NE. Forest Inst.* **2**(1): 73 (1982), syn. nov.

Calyx 6–8 mm long, hairs dense, 0.2–0.5 mm long; teeth 1.4–2 mm long, shorter than 1/5–1/4 of tube length, narrow triangular. Vexillum narrow obovate, apex retuse, (17–)18–20 \times 7–9 mm. Wings 15–16.5 mm long; lamina narrow oblong or semi-orbicular,

apex slightly notched, slightly longer than claw. Keel-petals 12–14 mm long, lamina semi-orbicular, apex obtuse, slightly shorter than claw. Ovary densely hairy, stipitate.

Habitat: On exposed grassland slopes, stream side banks, and sometimes on the floor of *Picea* forests, elevations between 2,000 m and 4,600 m.

Distr.: Afghanistan, W. Himalaya (Hindkush and Kashmir), Pamir, Tibet, Kunlun, Dzungarian Ala Tau, Tarbagatay, and C. Siberia (? Irkutsk).

Specimens. XINJIANG. Taxkorgan Xian: Maza to Kalaqigu, 3,600 m. WWF 4961 (KUN, TI); Kelaqigo, 3,600 m. W 870539 (KUN). Wuqia Xian: Wulagen, 2,300 m. W 870026 (KUN). Akto Xian: Wuyitage, 2,800 m. WWF 4800 (KUN, TI); loc. cit. WWF 4823 (KUN, TI). Yutian Xian: Kekeya, 3,000 m. W 870846 (KUN); Sukepiya, 3,000 m. W 870991

(KUN); Qirge, 3,900 m. W 871499 (fl. & fr.) (KUN); Maza, 4,600 m. W 871148 (fl. & fr.) (KUN). Pishan Xian: Taxgorx, 2,000 m. WOWF 1806 (KUN, TI); Kaxtax, 2,650 m. WOWF 3610 (KUN, TI); Buqun, 2,600 m. WOWF 1881 (KUN, TI); Naoarbatibuqiong, 2,600 m. WOWF 2452 (KUN, TI). Shache Xian: Kelatuzi, 3,000 m. W 870667 (KUN). Qiemo Xian: Aqiangxiang, Kongqibulak Grazing-land, 3,260 m. WOWF 3858 (KUN, TI); Aqiangxiang, Kongqibulak, 3,100 m. WOWF 3877 (KUN, TI).

12) *Astragalus oxyodon* Baker in Hook. f., Fl. Brit. Ind. 2: 125 (1876). Ali in Fl. West Pakist. 100: 178 (1977). K. T. Fu in Bull. Bot. Res. NE. Forest Inst. 2(4): 70 (1982). P. C. Li et Ni in Fl. Xizan. 2: 842 (1985). [Fig. 6A]

Astragalus nanjiangianus K. T. Fu in Bull. Bot. Res. NE. Forest Inst. 2(4): 69, f. 8–13 (1982), syn. nov.

Flowers with c. 1 mm long pedicel. Calyx 4.5–6 mm long, hairs blackish only, ascending, straight, on tube (including pedicels) c. 0.3 mm long, on teeth c.

0.7 mm long; teeth linear-subulate, 2.7–3.5 mm long, nearly as long as tube (2.2–2.7 mm long). Vexillum narrow obovate, apex retuse, base attenuate, 12–13.5 mm × 5.5–6 mm. Wings 10–11 mm long, shorter than keel-petals, lamina 6–6.8 mm long, narrow oblong, apex round, claw c. 4 mm long. Keel-petals 11.5–12.5 mm long, lamina arched-shape, apex round, 6.5–7 mm long, claw 4.5–5 mm long. Stamens 13–14 mm long. Pistils 13–14 mm long; ovary 4.5–5 mm long, dense minute hairs c. 0.2 mm long, tapering on both ends, stipes 2.5–3 mm long, style 6–6.4 mm long; ovules 6.

Habitat: On grassland in mountain slopes, elevation 3,200 m.

Distr.: W. Himalaya (Kashmir & Ladak) and western Kunlun.

Specimen. XINJIANG. Akto Xian: Aketashi, 3,200 m. W 870215 (KUN).

13) *Astragalus confertus* Benth. ex Bunge, Astrag. 1: 23 (1868); 2: 27 (1869). Type: West Himalaya, Parang Valley, 15,000 ft. *H. Strachey* 15 (K). Baker in Hook. f., Fl. Brit. Ind. 2: 123 (1876). Ali in Fl. West Pakist. 100: 160 (1977). Chater in Hara et al., Enum. Flow. Pl. Nepal 2: 106 (1979). Y. C. Ho in Bull. Bot. Res. NE. Forest Inst. 1(3): 109 (1981). P. C. Li et Ni in Fl. Xizan. 2: 838 (1985). P. Q. Li in Vasc. Pl. Hengduan Mts. 1: 965 (1993). [Fig. 6B]

Flowers with c. 1 mm long pedicels. Calyx 3.5–4.5 mm long, teeth 1–2 mm long, linear to subulate; hairs (including pedicels) blackish, ascending, straight, 0.15–0.5 mm long with c. 0.6 mm long, white, straight hairs. Vexillum obovate to widely obovate, apex retuse, 7–10 × 5–7 mm. Wings 7–9 mm long, lamina oblique, linear, apex round, 5–6 mm long. Keel-petals 6–8 mm long, lamina semi-orbicular, apex round, 4–5 mm long.

Habitat: On desert and grassland, elevations between 3,100 m and 4,800 m.

Distr.: W. Himalaya (Kashmir to Nepal), Tibet and Kunlun.

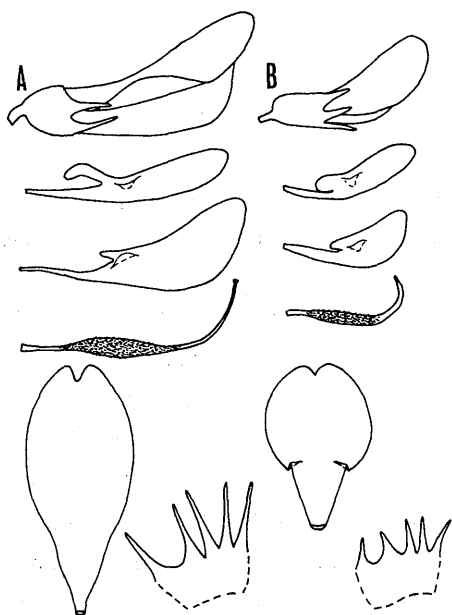


Fig. 6. A: *Astragalus oxyodon* Baker (W 870215). B: *A. confertus* Benth. ex Bunge (WOWF 2289). All × 2.5.

Specimens. XINJIANG. Taxkorgan Xian: Hongqilapu, 4,600 m. WWF 4901 (KUN, TI). Maza to Kalagiqu, 3,600 m. WWF 4973 (KUN); Subashidaban, 4,000 m. W 870311 (KUN). Akto Xian: Qiakelake to Muji, 3,400 m. W 870577 (KUN). Yutian Xian: Pulu, 3,750 m. WOWF 3690 (KUN, TI); Pulu, Kanyan, 3,800 m. WOWF 3767 (KUN, TI). Pishan Xian: Naza, 4,750 m. WWF 4775 (KUN, TI). Hotan Xian: Kaxtax, 3,650 m. WOWF 2038* (KUN, TI); loc. cit., 3,100 m. WOWF 2572* (KUN, TI). Qira Xian: Nuer, Yamei, 3,400 m. WOWF 2512* (KUN, TI); Nuer, 3,200 m. WOWF 1992* (KUN, TI). Qiemo Xian: Kongqibulaler, 3,150 m. WOWF 2061 (KUN, TI); loc. cit., 3,100 m. WOWF 2590 (fl. & fr.) (KUN, TI); Aqiangxiang, 3,200 m. WOWF 3842 (KUN, TI). Ruoqiang Xian: Yaziquan, 3,950 m. WOWF 3957 (KUN, TI); loc. cit., 3,900 m. WOWF 3948 (KUN, TI); Yaziquan to Aqqikkol, 4,000 m. WOWF 2654 (fl. & fr.) (KUN, TI); A pass between Yaziquan and Aqqikkol Hu, 4,450 m. WOWF 2289 (KUN, TI); Yixiakepati, 4,200 m. WOWF 4265 (fl. & fr.) (KUN, TI); Mingyalakdong, 4,120 m. WOWF 4187 (fl. & fr.) (KUN, TI); SE of Kumkol Hu, 4,150 m. WOWF 2312 (fl. & fr.) (KUN, TI); Piaqiriketagor, 3,950 m. WOWF 2159 (fl. & fr.) (KUN, TI); Aqqikkol, 4,280 m. WOWF 4019 (fl. & fr.) (KUN, TI); Hasheklei River, 4,720 m. WOWF 4152 (KUN, TI). TIBET. Ritu Xian, 4,230 m. W 871619 (fr.) (KUN). QINGHAI. Golmud Xian: 920 km in highway from Qinghai to Tibet, 4,500 m. WOWF 2865 (fl. & fr.) (KUN, TI); loc. cit., 4,400 m. WOWF 2839 (fl. & fr.) (KUN, TI).

This species varies greatly in the length of stem, the shape and size of leaflets as well as flowers. The specimens with an asterisk have relatively large flowers and leaflets. Though *A. confertus* has usually densely hairy ovaries and pods, the hairiness seems to vary dense hairy to glabrous. *Astragalus golumunensis* Y. C. Ho (in Bull. Bot. Lab. NE. Forest Inst. no. 8: 61, t. 5, 1980) seems to be only an extreme with glabrous ovary. W 871619 has glabrous to sparsely hairy pods,

but belongs to the variation of *A. confertus*.

Sect. *Myobroma*

14) *Astragalus alatavicus* Kar. et Kir. in Bull. Soc. Nat. Mosc. **15**: 344 (1842). Bunge, Astrag. **2**: 42 (1869). Boriss. et al. in Fl. URSS **12**: 224 (1946). Y. C. Ho in Bull. Bot. Res. NE. Forest Inst. **1**(3): 124 (1981). C. Y. Yang in Clav. Pl. Xinjiang. **3**: 134, t. 9, 1 (1983). [Fig. 7A]

Calyx 14–16 mm long, densely hairy, teeth 3–5 mm long, subulate. Corolla yellow. Vexillum 24–26×9–10 mm, narrowly oblong-obovate, apex retuse, base auriculate, clawed. Wings 23–24 mm long, lamina c. 11 mm long, linear, apex round, shorter than claw. Keel-petals c. 20 mm long, lamina c. 7 mm long, semi-orbicular, apex round, shorter than 1/2 of claw. Pods ellipsoid with beaked apex, base attenuate, 2–2.3 cm long, 6–8 mm deep, purplish red, dense hairs appressed and ascending, white, c. 0.6 mm long.

Habitat: Variable, on grassland, exposed flood ground or edge or floor of sparse *Juniperus* forests, elevations between 2,800 m and 3,600 m.

Distr.: Pamir (Alai Valley), Kunlun, Tien Shan, and Dzungarian Ala Tau.

Specimens. XINJIANG. Akto Xian: Aketashi, 3,120 m. W 870102 (KUN); loc. cit., 3,200 m. W 870225 (KUN); Qiaernong, 3,600 m. WWF 5029 (KUN). Taxkorgan Xian: Maza. W 870378 & 870333 (KUN); Maza to Kalaqigu, 3,600 m. WWF 4930 (KUN). Yutian Xian: Sukepiya, 3,200 m. W 871120 (KUN). Shache Xian: Kalatuizi, 2,800 m. W 870707 (KUN). Pishan Xian: Kaxtax, 2,800 m. WOWF 3609 (KUN, TI); Naoarbati, 3,100 m. WOWF 2417 (fl. & fr.) (KUN, TI); Buqun, 2,800 m. WOWF 1902 (fl. & fr.) (KUN, TI); Buqiang, 3,000–3,400 m. WOWF 3013 (KUN, TI).

15) *Astragalus myriophyllus* Bunge, Astrag. Turk.: 233 (1880). Boriss. et al. in Fl. URSS **12**: 224 (1946). C. Y. Yang in Clav. Pl. Xinjiang. **3**: 134 (1983).

Astragalus pamirensis Franch. in Bull. Mus. Hist.

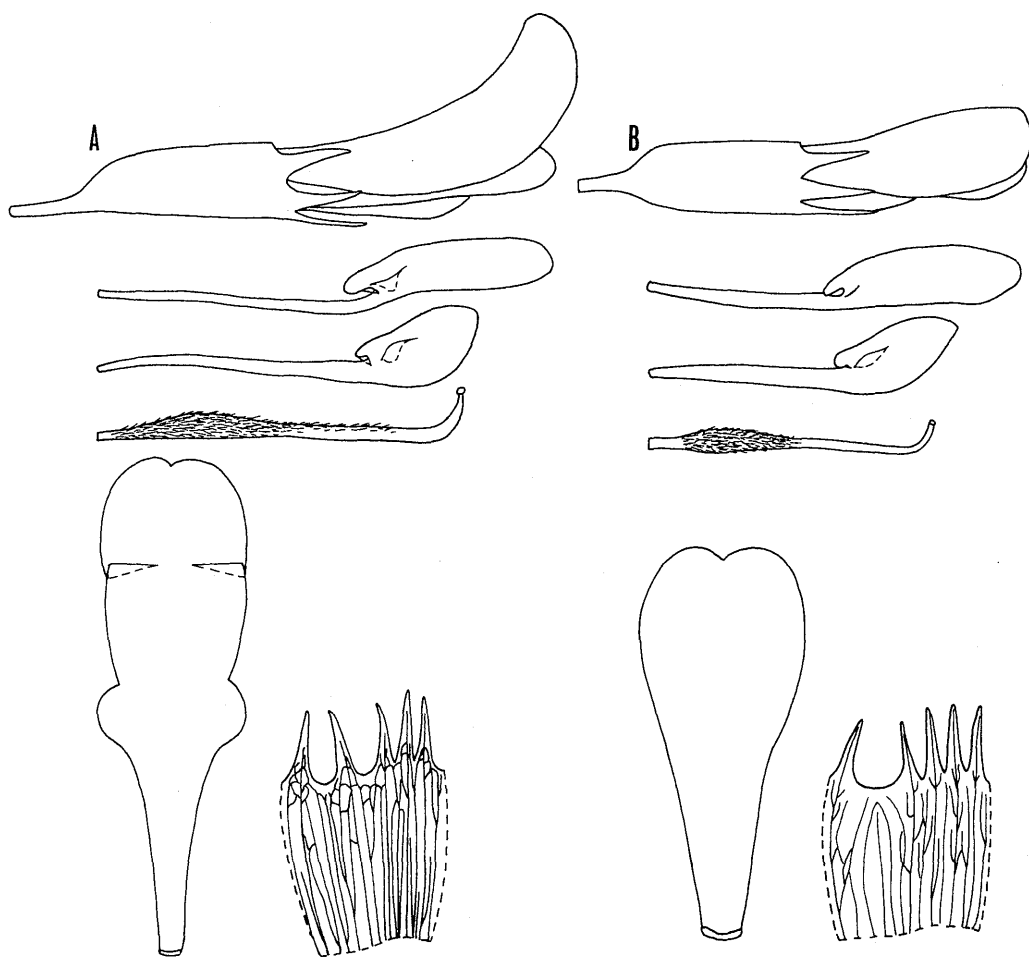


Fig. 7. A: *Astragalus alatvaicus* Kar. et Kir. (WOWF 1902). B: *A. talassicus* M. Pop. (WWF 4993). All $\times 2.5$.

Nat. Paris 2: 344 (1896).

Habitat: On sandy slopes, elevation 3,400 m.

Distr.: Pamir (eastward from Alai Valley) and western Kunlun.

Specimen. XINJIANG. Akto Xian: Qiakelale to Muji, 3,400 m. W 870588 (KUN).

This is similar to *Astragalus alatvaicus*, but different in having ovate large stipules, much more dense and long, conspicuous greyish white hairs on leaves, peduncles and calyx, and narrow oblong or narrow oblong ovate leaflets.

16) *Astragalus andaulgensis* B. Fedtsch. in Acta Hort. Petrop. 24: 213 (1905). Boriss. et al. in Fl. URSS

12: 193 (1946).

[Fig. 2C]

Astragalus staintonianus Ali in Candollea 17: 87, t. 13, 16 (1960), syn. nov. Type: Chitral. Khot An, N. of Mastuj, between Turikho and Mastuj Rivers. 14,000 ft. *Stainton* 2874 (BM).

Flowers yellow, 2.4–2.7 cm long. Calyx c. 1 cm long, hairs 0.8–1 mm long, pale brown, slightly curved, tube c. 7 mm long; lobes subulate, apex not pointed, c. 2 mm long. Vexillum obovate, 2.3–2.5 cm \times c. 1.7 cm, apex truncate. Wings c. 2.2 cm long, lamina narrow oblong, c. 1 cm long, apex round, shorter than claw c. 1.2 cm long. Keel-petals c. 2 cm long, lamina semiorbicular, c. 0.8 cm long, shorter than claw 1.2

cm long. Pistils c. 2 cm long; ovaries c. 1 cm long, glabrous; stipes 6–7 mm long.

Habitat: On flood river-bed, elevation between 4,200 m and 4,500 m.

Distr.: W. Himalaya (Chitral and Kashmir), Pamir, Kunlun and Tien Shan.

Specimens. XINJIANG. Taxkorgan Xian: Mintiegan, 4,300 m. WWF 4979 (KUN, TI); Keketulu, 4,600 m. W 870490 (KUN); loc. cit., 4,200–4,500 m. W 870504 (KUN).

Astragalus pamiroalaicus Lipsky (Acta Hort. Petrop. 26: 147, 1907) seems to fall the synonymy of this species, though we could not examine any authentic specimen.

17) *Astragalus talassicus* M. Pop. in Sched. Herb. Asiae Med., Fasc. 15: 21 (1928). Boriss. et al. in Fl. URSS 12: 189 (1946). [Fig. 7B]

Calyx 14–15 mm long, teeth linear-subulate, 3–4 mm long. Corolla yellow. Vexillum oblanceolate, apex retuse, 20–22 × 9–10 mm. Wings c. 20 mm long, lamina narrow oblong, apex round, 10–11 mm long. Keel-petals c. 16 mm long, lamina semi-orbicular, apex obtuse, c. 7 mm long. Ovary densely hairy.

Habitat: On gravelly slopes, elevation 4,300 m.

Distr.: Kunlun and Tien Shan (Kuraminskii, Talass, Chatkal' and Uzun-Akhmatskii regions).

Specimen. XINJIANG. Taxkorgan Xian: Mintiegan, 4,300 m. WWF 4993 (KUN, TI).

Sect. *Brachycarpus*

18) *Astragalus densiflorus* Kar. et Kir. in Bull. Soc. Nat. Mosc. 15: 329 (1842).

Var. *konlonicus* H. Ohba, S. Akiyama et S. K. Wu, var. nov. [Figs. 4 (below); 8A]

A typo caule minore quam 15 cm longi, saepe stolonifero et racemi cylindrici differt.

Perennial; caudex often stolons with scales ending aerial stems. Stems with long subterranean part; aerial part (including peduncles) 5–12 cm long, basally branched, 3 or 4 nodes, with simple hairs ascending, white or brownish, straight or curved, c. 0.6 mm long.

Leaves 2.5–5.5 cm long, uppermost two opposite, others alternate, imparipinnate; petioles less than 1 cm long, shorter than laminae, moderately to densely hairy; leaflets usually 13, narrow oblong or lanceolate, apex round, base round or cuneate with less than 1 mm petiolules, 5–14 × 2–5 mm, dense simple white hairs c. 0.7 mm long, appressed, curved on lower surfaces, margin and rachis, glabrous on upper surface. Stipules basally connate, triangular, 3–6 mm long, green, marginal portion hairy.

Inflorescences terminal, compact, cylindrical racemes with 20 or more flowers, 1.5–3 cm long; peduncles 2–4 cm long, densely hairy; bracts linear-subulate, longer than calyx, 4–6 mm long, hairs simple, ascending, blackish, c. 1 mm long.

Flowers with c. 1 mm long pedicels with dense blackish hairs. Calyx 4–6 mm long, hairs dense, c. 0.5 mm long, straight; teeth linear to linear-subulate, (1.5–)2–3 mm long. Corolla purple. Vexillum obovate to widely obovate, apex retuse, 8–9.5 × 5–6 mm. Wings (6–)7–8 mm long, lamina narrow oblong, apex round or rarely slightly retuse, 5–6 mm long. Keel-petals 5–7 mm long, lamina semi-orbicular, apex obtuse, 3.7–4.3 mm long. Ovary densely hairy.

Pods flat, nearly circular, beakless with persistent style, bilocular, smooth, cross-wrinkled, with dense simple hairs appressed or ascending, white or blackish, straight or curved, c. 1.2 mm long.

Type: China. Xinjiang: Yutian Xian: Ulugkula Lake, 4,800 m. Wu, Ohba, Wu & Fei 3719 (KUN-Holo; TI-Iso).

Habitat: Dominant species in sandy flood glacier valley, sandy desert, and gravelly or stony slopes, elevations between 3,950 m and 5,200 m.

Distr.: Endemic to central and east Kunlun Mts.

Specimens. XINJIANG. Yutian Xian: Ulugkula Lake, 4,800 m. WOF 3718 & 3719 (KUN, TI). Hotan Xian: Chalukou, 5,160 m. W 871194 (fl. & fr.) (KUN). Qiemo Xian: Kongqibulake, 4,000 m. WOF 2092 & 2094 (KUN, TI). Ruoqiang Xian:

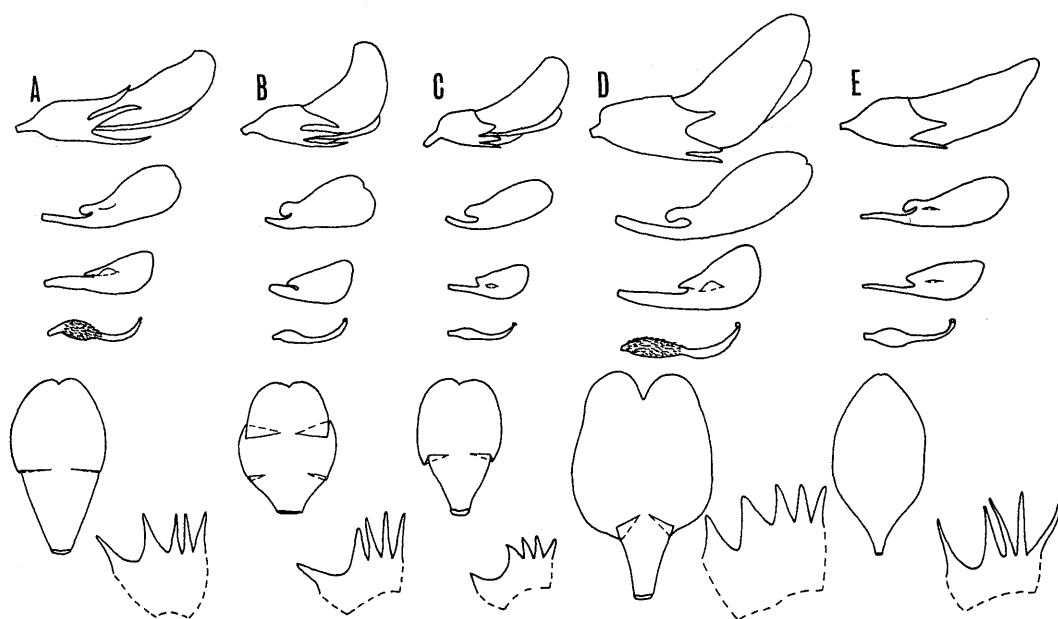


Fig. 8. A & B: *Astragalus densiflorus* Kar. et Kir., A: var. *konlonicus* H. Ohba et al. (WOWF 2094), B: var. *densiflorus* (WOWF 2434). C: *A. kunlunensis* H. Ohba et al. (WOWF 3778). D: *A. clarkeanus* (WOWF 4871). E: *A. fetissovii* B. Fedtsch. (W 871067). All $\times 2.5$.

Yaziquan, 3,950 m. WOWF 3950 (fl. & fr.) (KUN, TI); loc. cit., 4,500 m. WOWF 2752 (fl. & fr.) (KUN, TI); A pass between Yaziquan and Aqqikkol lake, 4,450 m. WOWF 2294 (fr.) (KUN, TI); Aqqikkol, 5,100 m. WOWF 2724 (KUN, TI); Mt. Qimantag, 4,600 m. WOWF 3974 (KUN, TI); Bing he, 4,300 m. WOWF 4217 (fl. & fr.) (KUN, TI); Mt. Muztag, 4,800 m. WOWF 3087 (fr.) (KUN, TI); Muztag, SE of Xuezaobi, 5,200 m. WOWF 2255 (fl. & fr.) (KUN); Muztag, Yueya River, SE of Xuezaobi, 4,900 m. WOWF 2250 (fl. & fr.) (KUN, TI). TIBET. Baingoin Xian: Whale Lake, 4,730 m. WOWF 4057 (KUN, TI); loc. cit., 4,850 m. WOWF 4088 (KUN, TI); Kunlun Mountains, NEN of Whale Lake, 5000 m. WOWF 2231 (KUN, TI). Qianghai. Golmud Xian: 920 km in Highway from Qianghai to Tibet, 4,500–4,600 m. WOWF 2851 (fl. & fr.) (KUN, TI).

Var. *densiflorus*

[Fig. 8B]

Bunge, Astrag. 2: 22 (1869). Baker in Hook. f., Fl. Brit. Ind. 2: 125 (1879). Boriss. in Fl. URSS 12: 59

(1946). Ali in Fl. West Pakist. 100: 161 (1977). Y. C. Ho in Bull. Bot. Lab. NE. Forest Inst. no. 8: 68 (1980). C. Y. Yang in Clav. Pl. Xinjiang. 3: 126 (1983). P. C. Li et Ni in Fl. Xizan. 2: 825 (1985). P. Q. Li in Vasc. Pl. Hengduan Mts. 1: 962 (1993).

Stems up to 15 cm long, internodes usually longer than leaves. Leaflets 5 or 6 pairs, upper surface glabrous, lower surface appressed, c. 0.5 mm long, white hairs. Racemes conical, usually 3, these from lowest axils surpassing others; bracts linear-subulate, c. 5 mm long.

Calyx 5–6 mm long, teeth linear, c. 2 mm. Vexillum narrow obovate, apex retuse, 7–10 \times 4–5.5 mm. Wings 6–7 mm long, lamina narrow oblong, apex retuse or round, 4–5 mm long. Keel-petals c. 5 mm, lamina 3–4 mm long.

Habitat: On grassland and meadow, elevations between 3,200 m and 3,730 m.

Distr.: Endemic to central region of the Kunlun Mountains.

Specimens. XINJIANG. Karakash, watershed. Caley in 1870 (K). Pishan Xian: Naoarbatibuqiong, alt. 3,300 m. WOWF 2434 (KUN, TI); Buqun, 3,200 m. WOWF 1858 (KUN, TI). Yutian Xian: Kekeya, 3,700 m. W 870805 (KUN); Pulu, 3,730 m. WOWF 3688 (KUN, TI).

This differs from var. *konlonicus* in having taller stems and usually three racemes, of which the lowest surpassing others. Var. *konlonicus* grows mainly on less vegetated places elevations above nearly 4,000 m while var. *densiflorus* occurs in grassland and meadows with other herbs and grasses in elevation between 3,200 m and 3,700 m. No morphological transitional form between them was found.

Astragalus pirphyrocalyx Y. C. Ho (in Bull. Bot. Lab. NE. Forest Inst. no. 8: 67, t. 8, 1980) seems to be close to this in having obovate standard and white-hairy ovaries.

19) *Astragalus kunlunensis* H. Ohba, S. Akiyama et S. K. Wu, sp. nov. [Figs. 8C; 9 (above)]

Astragali heterodonto Boriss. primo adspectu maxime similis, sed a quo pedunculo 10–15 (nec usque 8) cm longo et longitudine vulgo internodiis superanti, foliis 4–9 (nec 2–4) cm longis cum petiolo 1–3.5 (nec 0.5–1.5) cm longo statim dignoscendus. Ex affinitate *Astragali clarkeani* Ali, a quo stipulis basi connatis 3–4(–6) (non 6–7) mm longis, pilis caulium cineraceis nec nigris et floribus minoribus cum calyce 3 (nec 7.0–7.5) mm longo cum vexillo c. 7 (nec 13–14) mm longo bene distinctus.

Perennial herb with buried caudex with many short divisions. Stems 2–4, 20–45 cm long, simple, 6–8 nodes, with sparse appressed, c. 0.5 mm long hairs. Leaves 4–9 cm long; petioles 1–3.5 cm long, shorter than laminae, sparsely appressed-hairy; leaflets 12–18, oblong or oblong obovate, apex round or slightly retuse, base round with 1–2 mm petiolules, 7–19 mm × 4–6 mm, hairs c. 0.5 mm long on lower surfaces and rachis, glabrous on upper surface. Stipules basally connate, triangular ovate to tri-

angular, 3–4(–6) mm long, greenish, glabrous.

Inflorescences terminal and axillary, raceme capitate in flowering but elongate in fruiting, with 10 or more flowers; peduncles 10–15 cm long, usually longer than nodes, except for blackish hairy upper portion hairs sparsely or nearly glabrous; bracts linear, usually shorter than calyx-tube, 1–2.5 mm long, with sparse blackish hairs.

Flowers with c. 1 mm long pedicels with dense blackish hairs. Calyx 3 mm long, hairs dense, c. 0.2 mm long; teeth subulate, c. 1 mm long. Corolla purplish or often white. Vexillum widely obovate to orbicular, apex retuse, c. 7 × 5–6.4 mm, base more or less clawed. Wings 5–6 mm long, lamina narrow oblong, apex round, 4–5 mm long. Keel-petals 4–5 mm long, lamina semi-orbicular, apex obtuse, c. 3 mm long. Ovary usually glabrous.

Pods flat, widely obovate, beakless with remaining style, bilocular, grooved, cross-wrinkled, with dense appressed or ascending, white or blackish, straight or curled, c. 0.6 mm long, hairs.

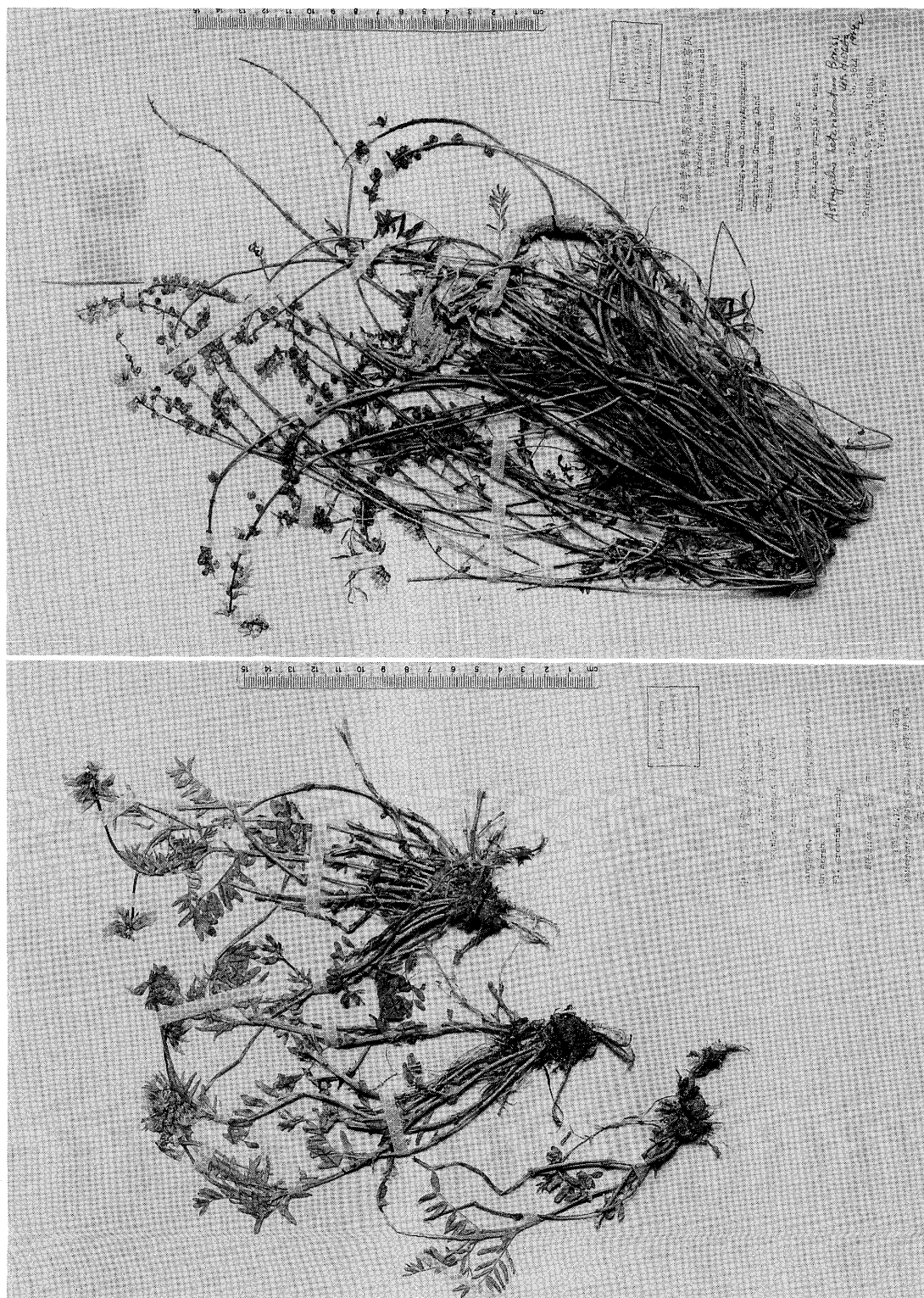
Type: China. Xinjiang: Qiemo Xian, Aqianxiang, Kongqibulaker Grazing land, alt. 3,260 m. Wu, Ohba, Wu & Fei 3844 (fl. & fr.) (KUN-Holo; TI-Iso).

Habitat: On rocky grassland along stream banks or slopes.

Distr.: Endemic to the Kunlun Mts.

Specimens. XINJIANG. Yutian Xian: Chalukou, 4,960 m. W 871244 (KUN); Pulu to Pulu Volcano, 3,300 m. WOWF 3676 (KUN, TI); Pulu, Kanyan, 3,800 m. WOWF 3778 (KUN, TI); Arxkula Lake, 4,300 m. WOWF 3759 (KUN, TI). Pishan Xian: Kaxtax, 3,300 m. WOWF 3645 (KUN, TI); Naoarbatibuqiong, 3,300 m. WOWF 2435 (KUN, TI). Qiemo Xian: Aqianxiang, Kongqibulaker Grazing land, 3,260 m. WOWF 3844 (fl. & fr.) (KUN, TI). Qinhai. Golmud Xian: Zidatan, 4,000 m. WOWF 2909 (KUN).

This differs from the most resembling species, *Astragalus heterodontus* Boriss. (in Trans. Tadzhik. Bazy. Akad. Nauk. 2: 161, 1936) in having long



peduncles up to 10–15 cm long and longer than internodes, longer leaves 4–9 cm long with 1–3.5 cm long petioles. *Astragalus clarkeanus* differs from this by the almost free stiples not adnate to petioles, the blackish hairs on stems and larger flowers with 7.0–7.5 mm long calyx and 1.3–1.4 cm vexillum.

WOWF 2435 and 3645 differs from the other specimens by the shape of vexilla, widely obovate against obovate or widely oblanceolate.

20) ***Astragalus clarkeanus*** Ali in Sind Univ. Sci. Res. J. **2**(2): 2 (1967); in Fl. West Pakist. **100**: 162 (1977). Type: Himalaya, Karakorum, alt. 14000 ft. *C. B. Clarke* 30243A on 9 Aug. 1876 (K).

[Figs. 8D; 9 (below)]

Flowers with c. 1 mm long pedicels. Calyx 7.5–8.5 mm long, hairs (incl. pedicel) dense, blackish, ascending and appressed, c. 0.5 mm long; teeth subulate, 2–3 mm long. Corolla purple. Vexillum oblong, apex emarginate, base clawed, 12–14 × 7–8 mm. Wings 11–12 mm long, lamina narrow oblong, apex retuse or retuse-truncate, c. 8 mm long. Keel-petals c. 8 mm long, lamina semi-orbicular, apex obtuse, 4–5 mm long. Ovary densely hairy.

Habitat: On grassland and meadow in mountain slopes, elevations between 3,400 m and 4,600 m.

Distr.: W. Himalaya (Karakorum range) and Kunlun.

Specimens: XINJIANG. Taxkorgan Xian: Maza, 4,400–4,600 m. W 870728 (KUN); Hongqilapu, 4,040 m. W 870450 (KUN); loc. cit., 4,600 m. WWF 4871 (KUN, TI). Akto Xian: Aketashi, 3,400 m. W 870147 (KUN); Qiaernong, 3,700 m. WWF 4648 (KUN, TI). Yutian Xian: Kekeya, 3,500 m. W 870833 (KUN).

This species is characterized by the blackish hairs on stems. Our specimens have stipules which are basally connate and highly adnate to petioles, but the type and other authentic specimens have almost free stipules not adnate to petioles.

21) ***Astragalus fetissovi*** B. Fedtsch. in Acta Hort. Petrop. **24**: 202 (1905). Boriss. in Fl. URSS **12**: 59

(1946).

[Fig. 8E]

Calyx c. 5 mm long, hairs dense, blackish, 0.3–0.5 mm long; teeth subulate, 2–2.2 mm long. Corolla ? yellow. Vexillum oblong, apex round-retuse, base attenuate or claw-like, 9.5–10 × c. 5 mm. Wings 7.5–8 mm long, lamina narrow oblong, apex round, c. 5 mm long. Keel-petals 6.5–7 mm long, lamina semi-orbicular, apex obtuse, 3.7–4.2 mm long. Pistil c. 5.5 mm long, ovary glabrous, c. 2.5 mm long, stipitate, ovule 2.

Habitat: On mountain slope, elevation 3,000 m.

Distr.: Kunlun and Tien Shan (Naryn range).

Specimen. XINJIANG. Yutian Xian: Sukepiya, 3,000 m. W 871067 (KUN).

This has been known only from the type locality in Naryn range in the Tien Shan Mountains. Our specimen differs from the type in having leaflets with round or round-apiculate apex, calyx-teeth slightly shorter than the tube, oblong, 9.5–10 mm long standard, 2.7–3 mm long wing- and keel-claws and particularly glabrous ovaries. In the species of *Brachycarpus* group the hairiness of ovaries is variable even in a single species like *A. densiflorus*.

Sect. **Cenanthrum**

22) ***Astragalus frigidus*** (L.) A. Gray in Proc. Amer. Acad. Arts Sci. **6**: 219 (1864). Bunge, Astrag. **2**: 28 (1869). Baker in Hook. f., Fl. Brit. Ind. **2**: 130 (1876). Boriss. et al. in Fl. URSS **12**: 33 (1946). Ali in Fl. West Pakist. **100**: 178 (1977). Chater in Hara & Williams, Enum. Flow. Pl. Nepal. **2**: 166 (1979)

[Fig. 10A]

Phaca frigida L., Syst. Nat. ed. **10**: 1173 (1759)

Astragalus lepsensis Bunge, Astrag. **2**: 29 (1869), syn. nov. Boriss. et al. in Fl. URSS **12**: 32 (1946). Y. C. Ho in Bull. Bot. Lab. NE. Forest. Inst. no. **8**: 53 (1980). C. Y. Yang in Clav. Pl. Xinjiang. **3**: 124 (1983).

Calyx tubular, 10–12 mm long, with sparse brownish hairs; teeth widely triangular, 1.5–2 mm long, as long as c. 1/8 of tube-length. Corolla yellow. Vexillum

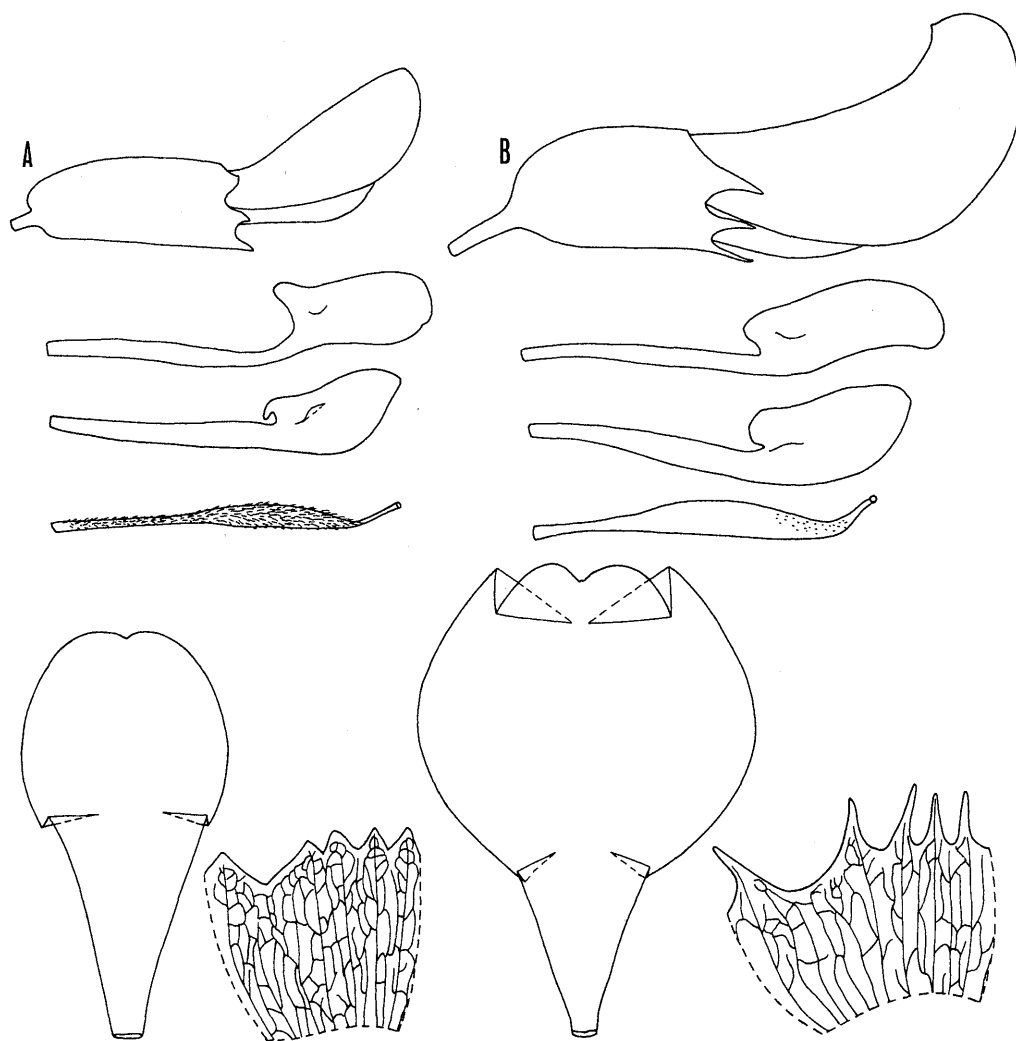


Fig. 10. A: *Astragalus frigidus* (L.) A. Gray (WWF 4999). B: *A. dictamnoides* Gontsch. (WWF 4845). All $\times 2.5$.

narrow obovate, apex retuse, tapering from middle, 20–23 \times 10–13 mm. Wings 20–22 mm long, lamina oblong, apex round, 8–9 mm long. Keel-petals 17–19 mm long, lamina semi-orbicular, apex round, 6–7 mm long. Ovary hairy, stipitate; style glabrous.

Habitat: On wet slopes, elevation 4,500 m.

Distr.: Northern Hemisphere including W. Himalaya, Pamir, Kunlun, and Tien Shan.

Specimen. XINJIANG. Taxkorgan Xian: Mintiegai, 4,500 m. WWF 4999 (KUN, TI).

We accept here a broader sense of the species delimitation. The Kunlun plants well agree with those of *A. lepsensis* described from Tien Shan (Ala Tau).

23) ***Astragalus dictamnoides*** Gontsch. in Notul. Syst. Herb. Inst. Bot. Acad. URSS 9: 116 (1946); in Fl. URSS 12: 31 (1946). [Fig. 10B]

Flowers yellow, with hairy, c. 2 mm long pedicels. Calyx 14–16 mm long, hairs soft, brown, curled, c. 0.8 mm long; teeth subulate, 2.5–3.5 mm long. Vexillum widely obovate, apex retuse, base clawed, 27–31 \times

17–19 mm. Wings 22–24 mm long, lamina oblong, apex round, c. 10 mm long. Keel-petals c. 20 mm long, lamina oblong, apex round, 8–9 mm long. Ovary sparsely hairy.

Distr.: Kunlun and Tien Shan (Ferganskiy Khrebet).

Specimens. XINJIANG. Akto Xian: Wuyitage, 2,800 m. WWF 4845 (KUN, TI); loc. cit. 3,250 m. WWF 4846 (KUN).

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Endnote

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2) Collectors abbreviations are as follows:

W: S. G. Wu. **WOWF**: S. G. (K). Wu, H. Ohba, Y. H. Wu and Y. Fei. **WWF**: S. G. (K). Wu, Y. H. Wu and Y. Fei.

大場秀章, 秋山 忍, 武 素功: 中央アジア崑崙山脈産植物の分類学的研究, 1. レンゲ属 (マメ科)

チベット高原の北縁とタクラマカン砂漠南端に位置する崑崙山脈の植物相はこれまで断片的な報告があるのみであった。レンゲ属については言及した論文は見当らない。著者らは1987年から3年間この地域の植物相を中国科学院青藏高原総合科学考察の一環として調査・研究し、レンゲ属に23種が見出された。本稿は同山脈レンゲ属をまとめた最初の分類誌である。種の区別は検索表で示し

The important alternative names of the counties and towns are as follows: Kaxgar (Kashgar); Pishan (Guma); Hotan (Kotan); Qiemo (Charchan, Ch'ieh-mo); Qira (Chira, Tse-le); Ruqiang (Charkhlik[h], Jo-ch'iang); Shache (Yarkand); Taxkorgan (Tash Kurgan); Yecheng (Karghalik); Yengisar (Yangi Shahr, Yangi Hissar); Yutian (Keriya).

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た。各種ごとに正名, 異名, 関連文献, 分布, 検討標本などを提示した。2種1変種, *Astragalus nematodioides*, *A. kunlunensis*, *A. densiflorus* var. *konlonicus* を記載した。*Astragalus hendersonii* Baker は *A. heydei* Baker の変種とする見解を述べた。新植物の他19種について従来の研究では不完全であった花についての記載を行った。